

The present state ammonia emissions in Slovak Republic and factors conditioning their reduction

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Abstract Development of the state of ammonia emission depends decisively on number of farm animals, which was more reduced from 1990 to 1998, cattle about 50%, dairy cows to 47%, other cattle to 52%, all pigs were reduced by about 33%, poultry about 11%. In 1999 was the same tendency with further reduction in farm animals. Dairy cows were reduced by about 3.5%, other cattle by about 7.13%; in sow was reduction by about 0.6%, fattening pigs were reduced 2.1%. In hens was reduction by 6.8%, in broilers by about 6.45%, poultry together by about 6.63 %. In 1999 was declared the decreasing staff animals only in goat and sheep, together by about 4.4%. In Slovakia was significantly reduced the ammonia emission absolutely and relatively, too, if we compare the reference year 1990 with compared years 1998 and 1999. It is compared with UN-ECE scenario too. In 1990 was in SK produced about 47 kt NH₃ per year. During next time we reduced the production markedly to 27 kt NH₃ in 1998; if it was calculated precisely—end staff of farm animals were ammonia emission only 25.7 kt NH₃. In UN-ECE scenario was prescribed for SK 39 kt, reality in SK was smaller about 12 kt, or about 13.3 kt per year. From whole ammonia balance was 16.2 kt produced in large scale farms, consisting of a number of production centres, in co-operatives or other economical forms at present (private form of production farms etc.) In 1999 was for all animal staff in SK 24.7 kt NH₃; from registered farm was emission in this year only 20.7 kt NH₃. Differences are at present time 4 kt NH₃ per year. Specific emission in SR is in present time for all animals staff 0.503 t NH₃.km⁻², from registered farm was only 0.422 t NH₃.km⁻². In reference year 1990 was specific emission 0.959 t NH₃.km⁻²; in Holland was in this time specific emission 7 t NH₃.km⁻².

Key words: *Ammonia emission, balance from animal production, possibility of their reduction*

Introduction

Within the process of sustainable landscape development are introduced also restrictive measures for reduction of emissions from production process recently. In agriculture it is first of all prevention of increase or reduction of glasshouse gases (CH₄ and CO₂) and reduction of ammonium emission (NH₃) from farm animals husbandry. Portion of ammonium emission from farm animals husbandry is decisive in total balance of ammonia production in the Slovak Republic also. Whole process is monitored by international working groups of experts (UN-ECE). Within the negotiation process it gains specific importance in advance also for SK at processing the information and standpoints and documents also for the organs of the EU. In West European countries is far higher intensity of breeding farm animals than in Slovakia. Particularly during the last years marked decrease, reduction in numbers of basic species of farm animals set in, within the process of economic transformation in our country and in surrounding countries as well, and so a marked decrease of ammonium emissions came about in SK.

Influence of technological and climatic factors on creation of emissions in breeding farm animals

There is need for more economic production, increase of reproductive and efficiency parameters and rationalization of working process in breeding farm animals at present. On the basis of the mentioned tendency it is then inevitable

to look for compromise solutions respecting the needs of animals in the technological sphere, demands of animals for production environment. In contradiction are new orientated demands for protection of environment, reduction of emission effects in breeding farm animals (Sottnik, 1997). Basic factors conditioning creation of emissions and their influence on environment are in fig. 1, 2.

The influence of animal production on environment cannot be eliminated in general. Basis of success of new technological processes will be provided at present only if the requests for reduction of effects of breeding farm animals on environment are accepted. That is the way it is abroad where are adopted quite demanding programme tasks aimed at reduction of emissions in intensive conditions of animal husbandry. Success of programmes is ensured provided that the approach to solution is complex. Also further technological innovations are inevitable. However, the mentioned process necessitates new, or supplementary investments to modernize systems of breeding, and methods of solution of technical measures aimed at reduction and moderation of impact of breeding farm animals on the environment (Sottnik, 1997).

Balance of ammonia emissions in breeding farm animals

Complex definition of load on environment caused by anthropogenic activities of mankind is on programme for a number of reasons, not excluding breeding farm animals. From this aspect is important the real impact

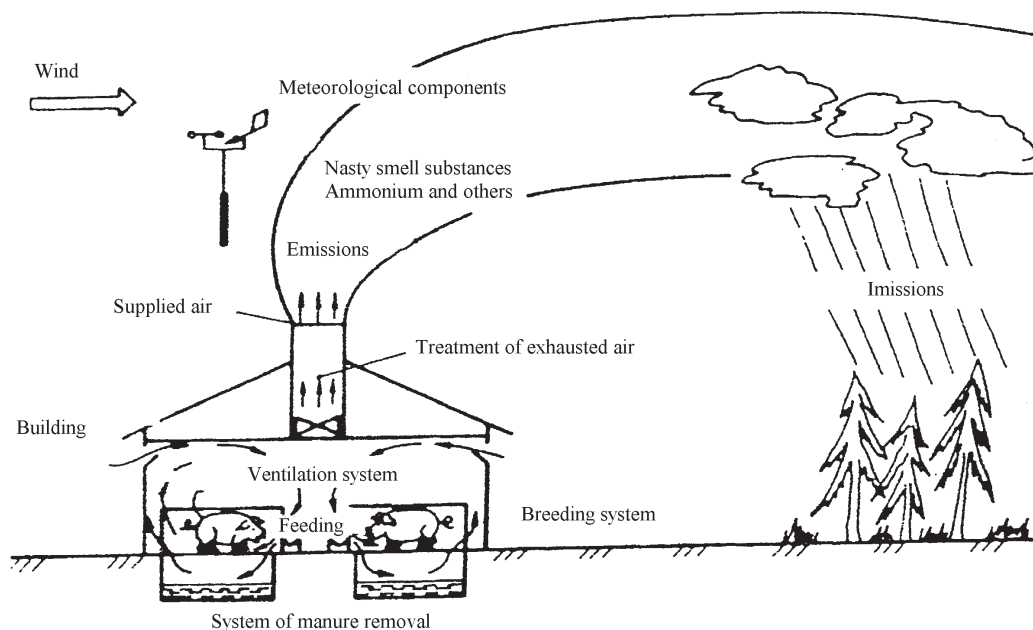


Fig. 1 Factors influencing ammonia emission from stables

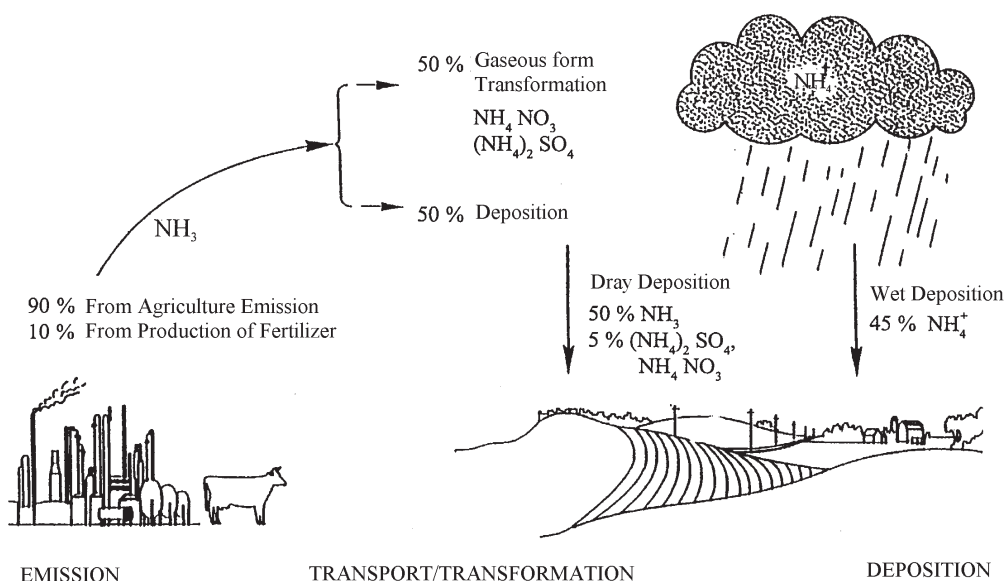


Fig. 2 Definition of ammonia emission

of animal breeding, its technological systems and equipment for manipulation and treatment of manure. Further on equipment for its economic processing and application that give a number of basic information about effects of ammonium emission on the environment. For the reason of gaining knowledge about the effect of breeding systems on environmental processes it is also necessary to define ammonia production in our country as a result of processes in animal breeding as well.

Livestock population was significantly reduced in SK during the last ten years. There are different reasons

for the decrease, partly the decreased demand for products of animal production resulting in overproduction also in consequence of liberalization of the market with the mentioned commodities. Also the increase of prices of input into production etc. is of great importance. Reduction of numbers of animals resulted in reduction of ammonia production in our conditions and so the ammonia emission is reduced by balance. It is reduced markedly more than it was determined in international scenarios by the working expert group of UN ECE for our country. At present is for Slovakia valid the emission

limit 39 kt NH₃ per year according to the central scenario. At the same time it is also necessary to point out that the absolute effect of ammonium emission from the production in the Slovak Republic was and is markedly lower than in West European countries; it can be supported also by the emission map of the European countries drawn ten years ago (see Geographical distribution of NH₃ concentration in European countries as described by Asman and Jaresveld 1990). Sensi, A. (in contribution Agriculture and Acidification, Eurostat-F3) mention decrease of acidifying emitting substances that can be identified in EU since 1980 and further on:

SO₂ decreased approximately by 27 %, NO_x by 6 %, and NH₃ by 8 %.

Ammonia – NH₃ is produced mainly in agriculture, i.e. from the production and application (spreading and spraying) faeces farmyard manure of animals, to a lesser amount from the production of artificial (commercial) fertilizers. Emission of NH₃ contributes not so much to acidification but more to implication of following environmental problems:

Ammonia deposition: large part of Europe has, has noticed substantial change in natural vegetation, in natural ecosystems caused by the influence of fertilization with nitrogen;

Eutrophization: deposition of atmospheric nitrogen increases eutrophization of soil, fresh waters (water systems) and sea surroundings are connected with increment of nitrogen leached into ground waters, streams and lakes, and it changes forest ecosystems.

Contribution of agriculture to acidification

Agricultural practice contributes mainly to NH₃ emission and is responsible for 95 % emissions. In Europe is liberation-volatility from excrements of cattle (animals) the main resource of ammonium emission from agriculture that contributes with more than 80 %. Approximately 10 – 20 % NH₃ is emission detected as volatility – liberation of ammonia from nitrogenous fertilization and from fertilized plants. Emissions caused by non-fertilized cultures are negligible.

Emission maps showing the distribution of NH₃, emission in 1990 (data on sub-regional level are valid for 1990) indicate that the highest amount of emission i.e. about 7 t NH₃.km⁻² is in The Netherlands; further the highly intensive animal breeding in northern Italy because of intensive fertilization (the attached emission map gives the level of specific emission 7 t NH₃.km⁻²).

Method of balance

Elaboration of total ammonia emission from animal breeding in SK is in line with Emission Inventory Guidebook, 15 February, 1996 B 1040-1. Method of total balance is based on average emission factors and number of animal species [in kg NH₃.animal⁻¹/animal⁻¹ per year]. At present they are already published in respective regulation of the Ministry

of Environment SK, Official Reports of ME SK, part 6, 1999 emission factors (basic documents were submitted to the RIAP Nitra).

Emission factors are calculated for adding from agricultural statistical register according to average annual states according to farm animal species. Technological and breeding emission is counted from given specification in the stable, outdoors stores, surface application-spraying the liquid manure and grazing. Total emission is balanced according to decisive, basic species and categories of farm animals, namely:

Dairy cows and the rest of cattle, sows and pig fattening, sheep and goats, layers, broilers and the rest of poultry, fur-bearing animals.

Results of NH₃ balance and discussion to measures

At present is also in conditions of Slovakia suggested a tendency of decreasing the ammonia emissions in agriculture that arise as a result of animal husbandry. Basic question at the given state, decrease in number of farm animals, mainly cattle, pigs and poultry (also within individual categories), is if this measure is economically acceptable. Further very important factor is real impact, significant effect on ecosystems that should be determined on the basis of experimentally defined emission load according to the mentioned parameters, and/or direct effect on eco-systems.

Therefore it is necessary in our conditions to take decisions and subsequent measures on exact decrease of the mentioned load, emissions of ammonia considering the gradual decrease of numbers of farm animals. From 1990 to 1998 decreased numbers of cattle by 50 %, out of it dairy cows by 47 %, the rest of cattle by 52 %. Total decrease in pigs was by 33 %, and poultry by approx. 11 %. The decrease continued in 1999, in cattle husbandry with cows by 3.5 %, the rest of cattle decreased by 7.13 %. Decrease in pig husbandry was with sows by 0.6 %, in fattening by 2.1 %. In 1999 was noticed an increase in sheep husbandry only, totally by 4.4 %. Decrease in poultry breeding compared with 1998 was in hens by 6.8 %, in poultry totally by 6.63 %, broilers by 6.45 %. The subject-matter of the problem in general and at assessment of four conditions is that the ammonium emissions absolutely expressed decreased rapidly in SK compared with 1990 that is the reference year also in scenarios of UN-ECE. During that period produced breeding farm animals in Slovakia approx. 47 kt NH₃ yearly. In the following period, as a consequence of decrease in numbers of farm animals in the comparative year 1998⁺, we markedly decreased also the ammonia emission that was in total volume approx. 27 kt NH₃ only, to the more precise numbers of farm animals in 1998 it was only 25.694 kt NH₃ yearly. It is markedly less compared with requirements of 39 kt NH₃ in the international scenario. Absolute level was lower by 12 kt NH₃ yearly, and/or by 13.3 kt NH₃ - for more accurate numbers. Out of the total balance are 16.2 kt NH₃ production of large capacity buildings, expressed out of statistical data about buildings and numbers of animals,

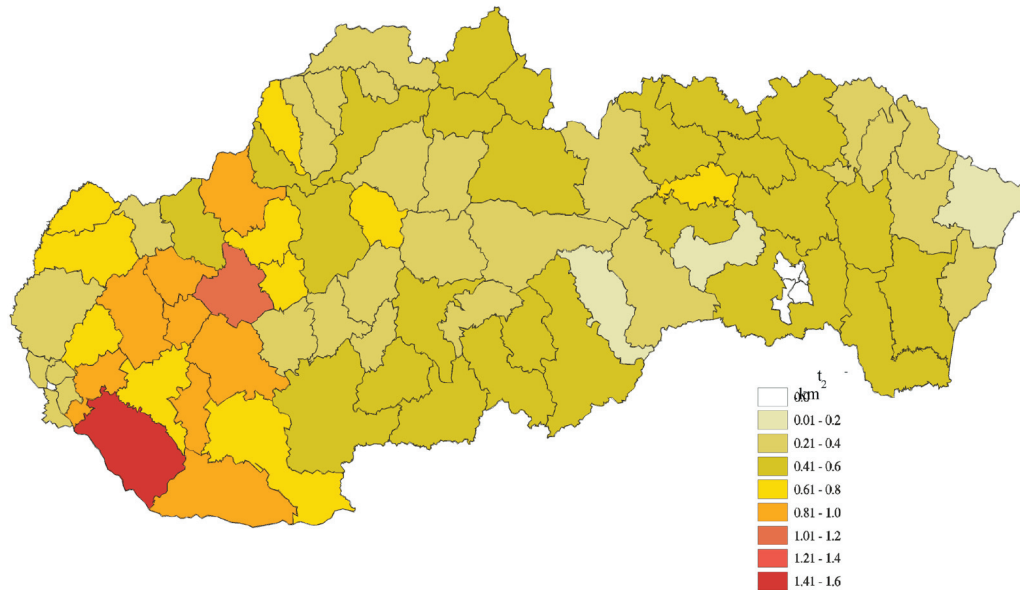
for enterprises as a whole (1996).

+) data about NH_3 emission in the year 1998 are assessed according to the estimation of numbers of farm animals determined in the conception of development in animal production in Slovakia - Development of animal production (1999)

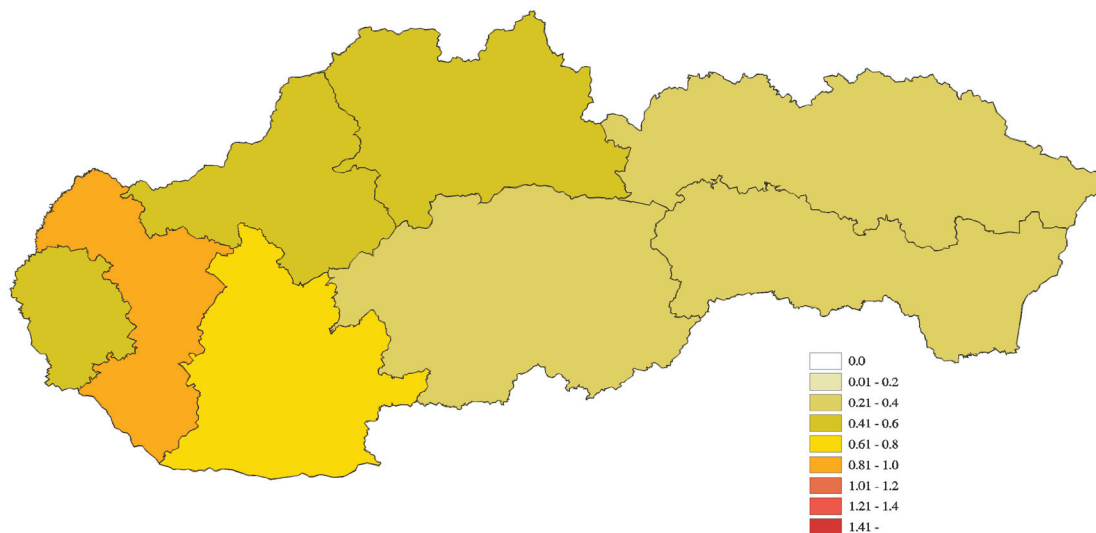
For 1999 was for total numbers determined the emission from breeding farm animals in SK 24.71 kt NH_3 , emissions from large-scale production were 20.70 kt NH_3 only. The difference to totally produced emission from animal

husbandry is 4 kt NH_3 yearly at present. Graphic depiction of emissions from animal husbandry as a whole, according to districts and counties, is in map 1-2, emissions from large-scale animal production in SK for districts and counties are in map 3-4.

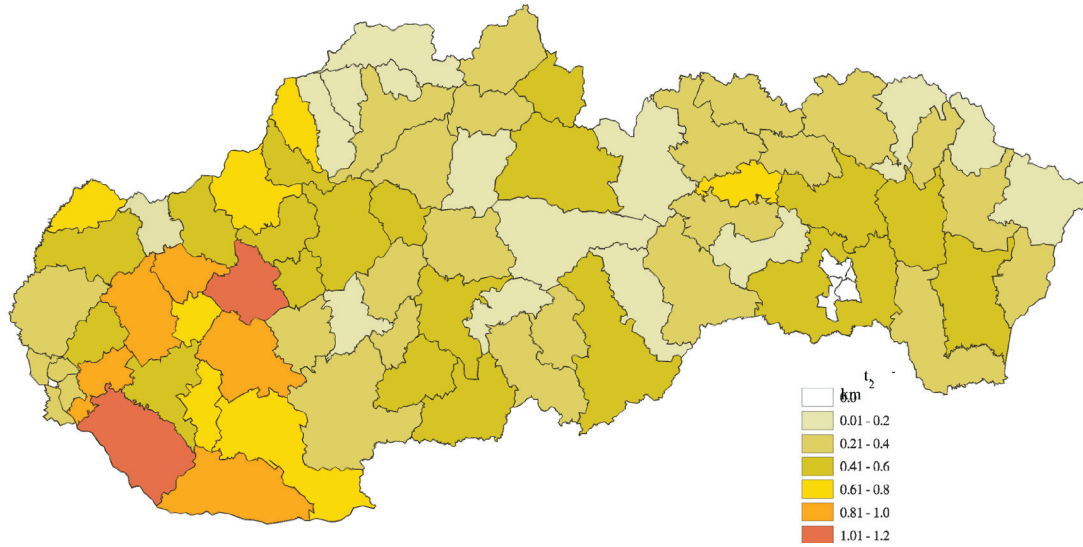
At present is in Slovakia the specific emission for all farm animals 0.503 t NH_3 . km^{-2} , from large-scale production it is 0.422 t NH_3 . km^{-2} . It was 0.959 t NH_3 . km^{-2} for all farm animals in the reference year; it was up to 7 t NH_3 . km^{-2} in the Netherlands in the mentioned period.



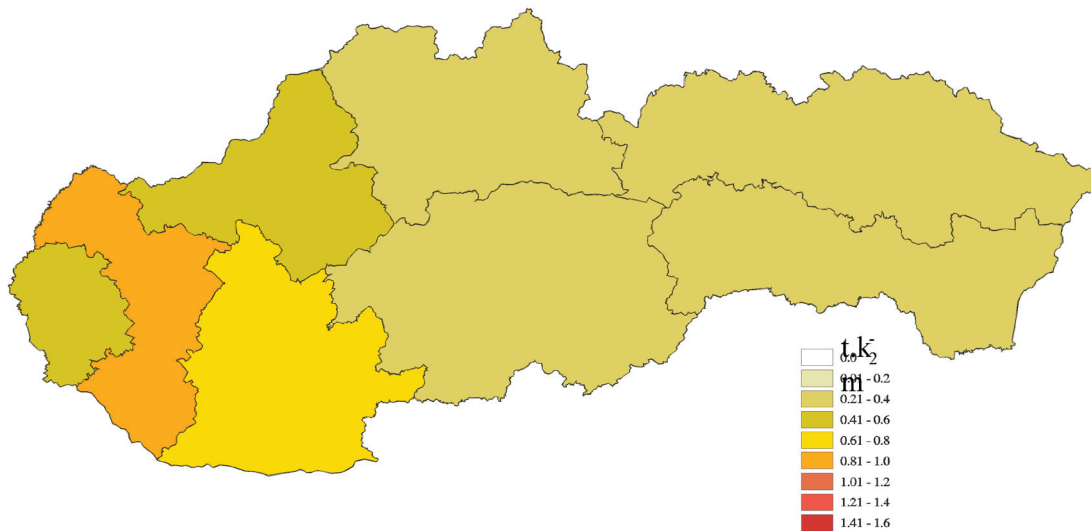
Map 1 NH_3 emissions from animal production for all animals in individual districts of Slovakia



Map 2 NH_3 emissions from animal production for all animals in individual counties of Slovakia



Map 3 NH₃ emissions from animal production for large-scale herds in individual districts of Slovakia



Map 4 NH₃ emissions from animal production for large-scale herds in individual counties of Slovakia

Structure of emission definition according to housing capacities

Buildings of large capacity in the given context of previous balances and criteria for examination of the type of farm, building are classed according to concentrations for cattle 500 animals and more, pigs 5000 animals and more, poultry 50 000 heads and more. However, it is not possible to state that the mentioned balance of large herds – large sources of contamination is to the full extent within one centre of production, where a “certain ecological impact” as a result of “point emission load” can be expected. During the following period moved the mentioned categorization of sources on the basis of valid regulations ordinarily to minimum concentrations, namely: in cattle breeding only to 100 animals and more, in pig breeding 500 animals

and more. The greatest definition change is in poultry husbandry where was the categorization shifted only to 5000 heads and more. Decrease in classification, categorization of large sources is differentiated 5x in cattle husbandry, 10 x in pig breeding, in poultry breeding originally up to 50 x, and/or 20 x (to 1000 heads only or 5000 heads only). Previous classification of large and medium (new) sources serves as the basis for settlement of fees for pollution of air by ammonium (NH₃) in SK at present. To objectify the mentioned legislative status in SK it is necessary to state that similar procedure is not usual in West European countries at ordinal 10-15 times higher load, pollution of the air in comparison of absolute and relative emission per km² or m³.

Possibilities of technological reduction of NH₃ emissions

To the problems of technological and breeding measures for decrease of ammonia emissions it is necessary to state unambiguously that there are necessary quite high financial investments for the whole process. To implement the mentioned process repeatedly in our country, too, it would be an important restructuring of the present state irrespective of hitherto level of technological modernization. Know-how known up to this time as for instance spraying – shower gathering shovel, specially adjusted gradients of standings, material composition and surface treatment, slope of floor, minimization of housing area, re-circulation and coagulation systems, pre-drying of droppings on belt and others are also system approaches; it is necessary to verify them experimentally in our conditions and then consider their repeated application in practice. Biofiltration of the removed air is a secondary solution; it is a highly efficient and effective method, however, quite expensive. In our country are known solutions linked with facilities of the veterinary sanitation institute, namely from the aspect of reduction of offensive smell emissions. Significant part in proportional decrease of emissions lies in the process of storage and manipulation with liquid and stable manure and in the technology system of their application and timeliness of embedding into soil if they are applied on the surface. Systems of direct application, or applications that decrease liberation of ammonia are with good prospects.

Conclusions

Development of ammonia emissions depends on livestock population that decreased markedly from 1990 to 1998. Number of cattle decreased by 50 %, out of it dairy cows by 47 %, the rest of cattle by 52 %. Total decrease in pigs was by 33 %, and poultry by approx. 11 %. The reduction continued in 1999; in cattle breeding with cows by 3.5 %, the rest of cattle by 7.13 %, in pig breeding with sow by 0.6 %, in pig fattening by 2.1 %. In 1999 was noticed increase only in number of sheep and goats totally by 4.4 %. In poultry husbandry decreased numbers of hens by 6.8 %, poultry totally by 6.63 %, broilers by 6.45 % compared with 1998. The substance of the problem in general and at estimation of our problems is that the ammonium emissions in absolute and specific – relative expression decreased rapidly in SK compared with 1990 that is the reference year also in scenarios of UN-ECE. At that time we produced in SK in cattle breeding approx. 47 kt NH₃ yearly. During the next period, because of decrease in numbers of farm animals in the comparative year 1998⁺), markedly decreased also the ammonia emission that was in total volume approx. 27 kt NH₃ only. For the numbers of farm animals made more accurate it was only 25.694 kt NH₃ yearly in 1998; compared with the international scenario was the absolute level lower by 12 kt NH₃ yearly, or by 13.3 kt NH₃ for the numbers of farm animals made more precise (the requisite decrease was to 39 kt NH₃ only). Out of total balance was 16.2 kt NH₃ produced in large

buildings, expressed out of statistical documents about buildings and numbers of animals, for enterprises as a whole (1996). ⁺) data about NH₃ for 1998 are assessed according to estimates of livestock population determined in the conception of development of animal production in SK. For 1999 was for total numbers determined the emission from breeding farm animals in SK 24.71 kt NH₃. In 1999 were emissions from large herds were 20.70 kt NH₃ totally. The difference compared with totally produced emission from breeding farm animals totally 4 kt NH₃ yearly at present. At present is for Slovakia specific emission for all farm animals 0.503 t NH₃.km⁻², from large herds 0.422 t NH₃.km⁻². In the reference year 1990 it was 0.959 t NH₃.km⁻² for all farm animals, in the Netherlands it was up to 7 t NH₃ km⁻² for the mentioned period. To decrease the ammonia emission it is necessary to change significantly technological systems in animal breeding, and the way of treatment, storage and application of manure in farm animal husbandry. This process will necessitate a considerable amount of investment means that are hardly to be found in our agriculture today.

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